

INDEX.

NOTE.—Titles of articles in Proceedings, and names of persons, are in CAPITALS.

ABRASION

Abrasion and wear of metals, 27.
 Abstracts of papers, publication of-, 2, 153. (See By-Laws.)
 Abutments, designs for-, 153.
 Accounts and returns of railroad companies. (See Uniform Accounts.)
 Act of Congress, appropriating money, and discontinuing Board to test Iron, Steel and other Metals, 100.
 ADDITIONS TO LIBRARY AND MUSEUM. (See LIBRARY.)
 — to List of Members. (See LIST.)
 Address of Vice-President THEODORE G. ELLIS, at Eighth Annual Convention, "Rise and Progress of American Engineering", 73.—Public improvements, 100 years ago; WASHINGTON our first civil engineer; his reports on canals and river improvements; the national roads, 73.—Internal improvements checked; Gen. BERNARD employed; work of the States; canals built; first condensing steam engine constructed; FITCH's steamboat and propeller, the Amphibious Digger; EVANS, TREVITHIC and HULL; the stern wheel, 74.—Advertisement of passenger sloop; FULTON's steamboats, his career; internal land communication; WERNWAG's timber bridges; advertisements of stage routes, 75.—Steamboats and mail coaches; the Erie canal; beginning and progress of railroads; first American locomotives, 76.—Locomotive works, engines exported; bridges and viaducts of timber, stone and iron; the Howe truss; increase of engineers; schools for instruction; Pacific railway; water

ADMISSION

works, gas works, sewerage; remarkable engineering feats, 77.—What engineers have done and may do; solar heat to be the motor, aluminum the metal, 78.
 Admission to membership. (See Membership.)
 Advertisement, of passenger sloop,—stage route, 75.
 Agricultural maps of France, 129.
 Air locomotive, compressed-, 91 (see Compressed);—pumps, 111.
 Alloys, copper-tin and others, 28.
 Alluminum, the metal of the future, 78.
 Amendments to By-Laws, 1, 15, 38, 79, 150, 152. (See By-Laws.)
 American bridges, 5, 113, 118, 174;—engineering, at Centennial Exposition, 3, 19, 38, 79, 86, 147,—description, 117,—memoirs, 4, 70, 135,—models, 24;—Rise and Progress of-, 73 (see Centennial Commission);—exhibits at Vienna International Exhibition, 158;—first condensing steam engine, 74;—first locomotive, 76;—iron and steel tests (see Tests);—technical literature, 118;—tunneling, 45.
 — Institute of Architects, 39.
 — Institute of Mining Engineers.—Action, 51;—co-operation, 4, 19, 149;—meetings, 69;—rooms, 19, 39, 70.
 — Iron and Steel Association, 39.
 — Metrological Society, 61.
 Amphibious Digger, 74.
 Analytical Mechanics, 161.
 ANNOUNCEMENTS.—American Institute of Mining Engineers, 69.—American Tunneling, 45.—Annual Conventions, 56, 68, 123.—Annual Meeting, 123, 132.—Appendix, 116, 171.—Card to Members, 45.

ANNUAL

- 95, 133.—Catalogue of Water Works' Exhibits, International Exhibition, 171.—Current Volumes closed, 178.—Discussions on Technical Education, 171.—Donations to the Library, 45, 95, 116, 133.—Franklin Institute, 70, 95.—Index to Proceedings, 35, 58, 104, 178.—Institution of Civil Engineers, 171.—Lawrence Water Works, 116.—List of Contents, 13,—of Members of the Society, 70,—of Topics, 57, 69.—Meetings of the Board of Direction—of the Society, 13, 35, 45, 56, 68, 70, 94, 104, 116, 123, 132, 171, 177,—of the Centennial Commission of the Society, 13, 35, 45.—Metric System of Weights and Measures, 178.—Papers, extra Copies, 124, 133, 177,—for the Norman Medal, 45, 95, 104,—Illustrations of—, on engineering Subjects, 123, 133, 177,—received, 35, 45, 57, 70, 94, 104, 171.—Photographs of Members, 45, 95, 116, 133.—Rooms of the Society, 58, 95, 104, 116, 133.—Tests of American Iron and Steel, 35.
- Annual Conventions.—Announcements, 56, 68, 79, 123;—attendance, 71;—business meetings, 2, 8, 14, 30, 57, 68, 79, 139, 153;—By-Law adopted, 2, 15, 153;—committees, 1, 15, 117, 173;—discussions, 57, 69, 139;—invitations, 49, 82, 84;—management, 1, 2, 8, 15, 30, 153;—matters of interest, 164;—minutes 71;—officers, 8, 175;—order of business, 78, 139, 148;—report, 139, 154;—rooms, 17;—time and place, 117, 136, 154, 164;—topics, 57, 69, 139. (See ANNOUNCEMENTS, MINUTES, REPORTS.)
- Meeting.—Announcement, 123, 132;—attendance, 135;—dinner, 123, 132;—minutes, 135. (See ANNOUNCEMENTS, MINUTES.)
- REPORT OF THE BOARD OF DIRECTION, 125, 135, 137. (See REPORTS.)
- Report of the Treasurer, 135, 138, 153. (See FINANCES.)
- Appendixes to Journal, 116, 171.
- Applications for admission to membership (see MEMBERSHIP);—for professional service, 12, 79, 153 (see BY-LAWS.)
- Appropriations for Tests of Iron, Steel and other Metals, asked, 29, 30, 40, 84, 90, 155;—made, 100. (See TESTS.)

AQUEDUCTS

- Aqueducts, 128.
- Architects, American Institute of—, 39;—Austrian Society of Engineers and—, 79.
- Architecture, National Bureau of—, 16, 38;—report on—, 160.
- Arch, practical determination of strains in the braced—, 16, 57.
- Armor plate, 27.
- ARTHUR, WILLIAM Y.—Death announced, 16, 36, 155;—resolutions passed, 16.
- Artificial blocks of masonry, 128.
- ASPINWALL, WILLIAM H.—Death announced, 14, 16, 154.
- Attendance at Annual Convention, 71;—at Annual Meeting, 135.
- Austrian Society of Engineers and Architects, presentation from—, 79.
- Autography, described, 107.
- Award of Norman Medal. (See NORMAN MEDAL.)
- Ballot. (See LETTER.)
- Ballots for members canvassed, 1, 15, 37, 47, 59, 70, 96, 117, 125, 136;—number to exclude, considered, 82, 152.
- Basins, beacons and lighthouses in France, 128.
- Beams, resistance of—, 27.
- Benefit of families of deceased members. (See MUTUAL.)
- Board of Censors to award the Norman Medal; reports, 136, 146, 154. (See NORMAN MEDAL, REPORTS.)
- of Direction.—Annual report, accepted, 135,—considered, 125, 137,—published, 138;—matters referred, 2, 3, 38, 48, 79, 82, 85, 136, 137, 148, 151, 153;—number of meetings, 139. (See ANNOUNCEMENTS, MINUTES, Recommendations, REPORT.)
- of Finance, Centennial Commission, constituted, 19. (See CENTENNIAL.)
- to test Iron, Steel and other Metals.—Act of Congress, 100;—appointment, 80;—appropriation, 29, 35, 100, 155;—chemical laboratory, circulars, 26;—committees, 27;—expenditure, 155;—organization, 26;—officers, 89;—plans approved by American Institute of Mining Engineers, 51,—American Iron and Steel Association, 39,—Columbia College School of Mines, 40,—Cornell University, 62,—Lyceum of Natural History, Oberlin College, 40,—the Board of Direction, 17, 29,—University of Wisconsin, 40;—

BOILER

- report, 29;—resolutions adopted, 17, 29, 35;—Secretary, 84, 89, 155;—testing machine, 29, 155;—the Board discontinued, 100;—work, 27, 60, 84, 155. (See Tests.)
- Boiler, explosion, 125;—marine-, 70, 173.
- BOOK NOTES.—Analytical Mechanics, 161.—Graphical Statics, 49.—Iron Highway Bridges, 174.—Reports on the Vienna International Exhibition, 158.
- Books of reference, 145.
- ON ENGINEERING AND TECHNOLOGY; LIST OF—, 10, 32, 41, 52, 63, 91, 100, 114, 121, 129, 165, 175.
- Boston Society of Civil Engineers, the metric system, 62, 178.
- Bread making, 159.
- Bridges.—Abutments, 112, 118;—American bridges, 5, 113, 118, 174;—circular on—, 5;—committee on averting Bridge Accidents, 82, 146;—bridge of Arcole, of St. Servan, 126;—construction, 5, 113, 118;—continuous girders, 50, 78;—crane bridges, 112;—deflections, 107;—discussion of—, 78, 83;—draw-bridges, 112;—East river, 37, 171;—European bridges, 5, 118, 174;—failure, 37, 40;—foundations, 113, 114, 119;—highway bridges, 174;—in France, 126;—in the Netherlands, 110, 112;—in Switzerland, 107;—iron bridges, 5, 37, 40, 77, 107, 174;—masonry, 38, 113, 119, 171;—“New Portage Bridge”, 3, 37, 83;—piers, 112, 113;—railway, 127;—St. Louis bridge, 50;—superstructure, 120;—swing bridges, 126, 128;—stone bridges, 77;—tests, 107;—the Aare bridge, 107;—timber bridges, 75, 77;—Verrugas bridge, 83;—viaducts, 77, 111, 126, 160;—WERNWAG’s bridge, 75;—wooden bridges, 5, 108. (See Girders, Viaducts.)
- Bronze, compressed-, 131.
- Bureau of Architecture, 16, 38.
- Business meeting at the Annual Convention, 2, 8, 14, 30, 57, 68, 79, 139, 153. (See ANNUAL, By-Laws.)
- By-Laws.—Amendments, relating to—abstracts of papers, 2;—applications for professional service, 2, 79;—appointment of special committees, 2;—chairman and business of Annual Conventions, 2, 151;—definition of Civil Engineer, 38;—duties of the President, 2;—officers’ receptions, 2, 15;—resident and non-

CAISSONS

- resident members, 3.—Changes proposed, 150, 152;—referred to, 153;—substitutes offered, 2, 79.
- Caissons and air pumps, 111.
- Canals, and inland navigation, 24, 74;—in early times, 74;—in France, 127;—in Holland, 109;—Erie canal, 76.
- Cards, of introduction, 60;—to members, 45, 95, 103.
- Cars, descriptions of—, 127.
- Cast iron, 28.
- iron pipes, 98, 161.
- Catalogue, of exhibits, Centennial Exposition, 126, 171;—of library, 145.
- Cement for masonry, 3, 90, 99, 162.
- Censors. (See Board.)
- Centennial Commission of the Society, 3, 19, 38.—Action proposed, 5.—American engineering progress, 20, 24, 48, 147, 156.—Assistance required, 4.—Benefits expected, 157.—Board of Finance, 19.—Bridge models and plans, 6.—Circulars from Sub-committees, 4.—on bridges and bridge constructions, 5.—on canals and inland navigation, 24.—on electric engineering, 5.—on foundations and masonry, 22.—on gas engineering, 23.—on hydraulic motors and machines, 25.—on mechanical engineering, 22.—on metallurgical engineering, 20.—on objects and work, 19.—on park and landscape work, surveying and geodesy, 26.—on railroads and rolling stock, 23.—on river and harbor improvements, 5.—on sewerage and sanitary engineering, 39.—on steam engineering, 20.—on water works, 4.—Committees appointed, 3, 19, 38.—Contributions secured, 19.—Contributions to library and museum, 144, 150.—Co-operation with American Institute of Architects, 39.—American Institute of Mining Engineers, 19, 39, 149.—Franklin Institute, 19.—Cost and expenses, 19, 22, 26, 86, 149, 157.—Donations received, 144.—Exposition buildings, 3.—Finance reports, 136, 157.—Foreign engineers, 19.—Historic objects desired, 20.—Information sought, 19.—Meetings held, 13, 35, 45.—Memoirs and records to be published, 4, 19, 21, 24, 39, 86, 149, 157.—Objects in view, 3, 5, 19, 20.—Organization, 4.—Plans proposed, 21, 48.—Policy defined, 5, 24.—

CERTIFICATES

- Records requested, 20.—Reports, 86, 136, 156, 157.—Resident Secretary, 5, 39, 48, 156.—Rooms had, 19, 39.—Society and other exhibits, 49, 156.—Space in buildings, 3, 4, 19, 20, 38, 149, 156.—Sub-committees, members and work, 3, 38, 149.—Subscriptions received, 39.—What was proposed and done, 4, 19, 21, 39, 87, 149, 150.
- Certificates of membership, 152.
- Chain cables and wire ropes, 27.
- Chairman of Annual Convention, elected, 78. (See By-Laws.)
- Change of the Society's rooms. (See Quarters, REPORTS, Rooms.)
- Changes and Corrections in List of Members. (See LIST.)
- Charts, hydrographic-, 110.
- Chemical laboratory of Board to test Iron, Steel and other Metals, 26.
- Circulars relating to:—American tunneling, 45;—Annual Convention, 136;—Centennial Commission (see Centennial);—Civil Engineers' Insurance League, 1;—metric system of weights and measures, 178;—nomenclature and classification of masonry, 88;—tests of iron and steel, 26 (see Tests).
- Civil Engineer, meaning of-, 38, 151;—our first-, 73.
- Engineers' Insurance League.—Letter ballot applied, 1, 152;—plan discussed, 8;—votes canvassed, 1.
- Engineers, members of the Institution of-, 171.
- engineering, report on-, 160.
- Classification of masonry (see Nomenclature);—of members (see Membership).
- Coal and Navigation Company. History of the Lehigh-, 48.
- Columbia College School of Mines, 40.
- Columns, resistance of-, 27. (See Tests.)
- Commissions to the Vienna International Exhibition, reports, 158.
- Committee of Lyceum of Natural History, 40.
- reports, 60, 141;—work, 120.
- Committees, appointment of Standing Committees, 137;—for special work, 147;—on special engineering subjects, By-Law adopted, 2, 153,—method discussed, 152,—resolutions offered, 48.
- of Board to test Iron, Steel and other Metals, 1, 27;—of Centennial Commission of the Society, 3, 38, 149.

COMPRESSED

- on:—American Engineering at the Centennial Exposition, appointment, 3, 147, 148 (see Centennial Commission);—Annual Conventions, appointment, 15, 117, 173,—reports, 154;—Applications for Membership, appointment, 138;—Change of Name of the Society, appointment, 138;—Change of Rooms, discharged, 82,—report, 87, 137;—Failure of Dam at Worcester, ballot, 48, 49, 59,—report and discharge, 85,—work, 147;—Finance, appointment, 137;—Form, Weight, Manufacture and Life of Rails, report and discharge, 85,—work, 146;—Founding an Engineering Library and Museum, discharge, 82,—work, 148;—Furnishing Rooms, appointment, 138;—Guaging of Streams, chairman, 136,—reports, 61, 84, 86, 136,—work, 147;—Library, appointment, 137;—Means of averting Bridge Accidents, discharge, 82,—work, 147;—Memoirs of deceased Members, appointment, 96;—Mutual Benefit Society, work, 148;—National Recognition of the Society, report and discharge, 82, 87, 137,—work, 148;—Nomenclature and Classification of Masonry, reports, 86, 88,—work, 147;—Officers' Receptions, appointment, 17, 138,—work, 152;—professional subjects, list of-, 146;—Policy of the Society, work, 148;—Quarters of the Society, appointment, 138;—Railway Signals, discharge, 85,—work, 146;—Resistances of Railway Trains, ballot, 48, 49, 59,—reports, 86, 136,—work, 147;—Revision of the Constitution, appointment, 138;—Seniority of Members, appointment, 3,—work, 152;—Technical Education, appointment, 38,—reports, 49, 86,—work, 147;—Tests of American Iron and Steel, reports, 60, 34, 155,—work, 146;—Uniform Accounts and Returns of Railroad Companies, appointment, 136, 137,—report, 136, 157,—work, 147.
- Compressed Air Locomotive.—Description, valves, working pressure, advantages in mines and tunnels, 1.
- Condensing steam engine, first American-, 74.
- Conditions of membership, 151. (See Membership.)

CONDUIT

- Conduit under pressure, 48, 58.
 "Connected segmental Marine Boilers, a Demonstration of the Principles of their Construction", a paper, 70, 173.
 Constitution, revision of-, 138. (See Committees.)
 "Consumption and Waste of Water delivered by public Works", a paper, 37.
 Contents of Proceedings, 142; — of Transactions, 13.
 Continuous girders, 45, 50, 78. (See Bridges, Theory.)
 Conventions of the Society. (See Annual.)
 Copper-tin alloys, 28.
 Cork Run tunnel, 58, 137.
 Cornell University, 62.
 Correspondence. (See Selections.)
 Corrosion of metals in actual use, 27.
 Cost and size of Journal of the Society, 141.
 — of railways in Switzerland, 107.
 Crane bridges, 112.
 "Croton Water Works and Supply" discussed, 16, 35, 47, 48, 59, 84, 86. (See Notes.)
 Culverts, stone, 107.
 "Cut-offs on the Mississippi, their effect on the Channel above and below," a paper, 86, 95.
 Cut-off walls, 98, 162.
 Cuts and excavations, CULMANN's method of calculating, 107.
 Dam at Worcester, failure described, 47; — resolution offered, 48; — ballot had, 49, 59; — report, 85; — committee and work, 152.
 Dams for Reservoirs, 97, 161.
 — Construction of earthen dams, causes of failure, spiling wall, 97. — Cracks, leaks, cut-off walls, outlet passages, abrupt angles, puddle walls, base of embankment, modern practice, failures from overflow, 98.
 — Specifications for repairing Dam at Worcester. Description, dimensions, earthen embankment, iron pipes, gate house and well (98), slope wall, pavement, waste way, 161 — spiling wall, supply and waste pipes, tooth-ing (99), puddle wall, cracks and slides, intermixing material, laying pipes and masonry, cut-off walls, material for puddle, embankment and supporting walls, stone for gate house and well, hydraulic cement, selection of material, how

DECEASED

- puddle wall shall be made, 162, — how embankment shall be built (99), gate house and gates described, foundations, water and waste pipes, 100, 163.
 — in France, 128; — in Switzerland, 108.
 Deceased members, 14, 36, 96, 134, 154, 178.
 Depot at Paris, Orleans Railway, 127.
 "Descriptions and Results of hydraulic Experiments with large Apertures at Holyoke, Mass.", a paper, 84, 146.
 "Design and Erection of the Exposition Buildings" at Philadelphia, 78.
 Determination of the Resistances of Railway Trains, 50.
 Discharge of Water from Jets and in long Mains. — Description, 37, — diagram, 90.
 Discussions, at Annual Conventions, subjects announced, 57, 69, — comment, 140; — on Technical Education, 79, 147, 171.
 Docks in France, 128.
 Donations to Library. (See LIBRARY.)
 Drainage works of the Netherlands, 108.
 Draw-bridges. (See Bridges.)
 Drawings, method of reproducing-, 107.
 DUDLEY's dynograph, 38. (See Resistances.)
 Dues of members, 151.
 Dykes, canals and embankments, 109.
 Earthen, dams, 97; — embankments, 98, 161.
 Education, primary-, 159; — technical, 38, 49, 79, 86, 147, 171. (See Technical, Vienna.)
 Electric engineering, 5; — FRANKLIN's machine, 95.
 Embankments, construction and materials, 98, 109, 162, 163.
 Engineer, Civil — compared with Mechanical and Mining-, 38, 151.
 Engineering, American, 70, 73, 117, 135 (see American); — electric-, 5; — gas-, 23; — hydraulic-, 160; — mechanical-, 22; — metallurgical-, 20; — sanitary and sewerage-, 39; — steam-, 20.
 — EXHIBITS AT THE INTERNATIONAL EXPOSITION, 105, 126.
 — of France. — The French building, interest of French engineers, collection of the exhibit, catalogue, map of France, methods of road construction, models of viaducts and bridges, arch centering, 126. —

ENGINEERING

Depot of Orleans Railway, descriptions of railroad rolling stock and rails, locomotive engines and cars, improvements of rivers and harbors, canals, aqueducts and locks, 127.—Maritime works, docks and basins, port improvements, elevation and distribution of water, dams, beacons, light houses, and foundations, 128.—Agricultural and geological maps, illustrations of public works, engineering schools, 129.

—of Switzerland.—The St. Gothard tunnel, location and construction, 105.

—Rock-boring machines, rate of progress, geological record, complete working drawings and yearly reports. The North-Eastern Railway, manner of construction, alignment and location, 106, — Estimates of cost, maintenance of permanent way, plans for bridges and culverts, details of iron bridges, lattice and plate girders, tests, loads and deflections, the Aare bridge, tracings, how made, autography, specifications of railroad work.

Hydraulic works, 107,—literature referring to flow of water, results obtained, water power of Switzerland, turbines used, distribution and transmission of water power, improvements of rivers, details and statements of cost of other railroads, wooden bridges, 108.

—of the Netherlands.—Drainage works, canals and bridges, 108.—Models of the country, the dykes, ship and other canals, the embankments. Haarlem lake, its drainage, the engines used; construction of jetties; models and drawings, the mattresses, method of reclaimment, loss of area, 109.—Hydrographic charts, canals, locks and gates, the "Blanken" gate described, piles and pile drivers, pier in harbor of Harlingen.

Foundations, the plenum-pneumatic process, 110;—method in use described, the caissons and air pumps. Bridges in Holland, model of Kuileberg viaduct, construction of the trusses, lattice girders, 111;—appearance of structure, pin connection trusses, false works required. Bridges at Bommel and over the Hollandch Dieps described, their abutments and piers, draw-bridges, that at Dordrecht describ-

ENGINEERS

ed, crane bridges, other plans for bridges, 112.—Designs for abutments, 113.

—library and museum (see Library);—papers, 123, 133, 177;—remarkable feats, 77;—reports, 159;—schools for instruction, 77, 129.

Engineers, and Architects, Austrian-, 79;—Institution of Civil-, 171.

—as experts, 8, 80;—increase of-, 77;—instruments, 159;—reception of-, 60.

Engines, locomotive, 77, 95,—pumping, 109, 116, 128, 142, 161.

Erection of the Verrugas bridge, 83.

Erie canal, 76.

EVANS, OLIVER, 74, 95.

Excavations and cuts. (See Cuts.)

Exhibitions, International-, 158. (See Centennial, Vienna.)

Experiments, hydraulic, 84, 146,—on railway traction, 38, 48, 49.

Exposition buildings, description, 3, 78, 160.

Extra copies of Papers, 124, 133, 177.

"Fac-simile Telegraphy", a paper, 37, 58.

Failure of Dam at Worcester, described, 47;—resolution offered, 48;—ballot had, 49, 59;—report, 85;—committee and work, 152.

"Fall of an Iron Bridge" described, 40.

Federal charter recommended, 87, 88.

Fees and dues of members, 151.

Finance, Centennial Commission Board of-, constituted, 19;—Reports of Committee, 136, 157. (See Centennial, Reports.)

— Standing Committee on-, appointed, 157.

FINANCES OF THE SOCIETY, STATEMENT OF-, 17.

FITCH's steamboat and propeller, 74.

Flow of water, literature of-, 108.

Foreign engineers, 19, 60.

Forestry, reports on-, 159.

Form, Weight, Manufacture and Life of Rails; Committee on-, report, 85;—work, 146.

Fortifications and government roads, 74.

Foundations, and masonry, 22;—American-, 119.—For bridge piers, 113,—gate-house, 100, 163,—light-houses and walls, 128;—The plenum-pneumatic process, 110.

France, sketch of engineering exhibit at Centennial Exposition, 126. (See Engineering.)

FRANKLIN

- Franklin Institute, co-operation, 19;—historic objects, 95;—rooms, 17, 19, 70.
- FRANKLIN'S electric machine, 95.
- FULTON'S steamboat, his career, 75.
- Furnishing rooms, committee appointed, 138.
- Gas engineering, 23;—works, 77.
- Gates, gate-house and well, Worcester dam, 99, 161;—locks and canals in the Netherlands, 108.
- "Guaging of Streams, a special Case," a paper, 86, 94;—in connection with observations of rainfall,—committee and work, 136, 147,—discussion, 118,—reports, 61, 84, 86, 136.
- Geodesy, surveying and—, 26.
- Geological maps of France, 129.
- Girders, and columns, resistance of,—27;—lattice and plate—, 107, 111;—strains in—, 160, 174.
- Government roads and fortifications, 74.—recognition of the Society, 88.
- Graphical Statics, 49.
- Haarlem lake, its drainage, 109.
- Harbor improvements, American, 5;—European, 109, 127, 160;—at Wilmington, Cal., 117, 125.
- Head of Passes at mouth of Mississippi river, 137.
- Highway Bridges, Iron, 174. (See Iron.)
- Historic objects at Franklin Institute, 95.
- "History of the Lehigh Coal and Navigation Company and its Works", a paper, 48.
- HOWE truss bridge, 77.
- HULL, EVANS and TREVITHIC, 74.
- Hydraulic, cement, 99, 162;—engineering, 160;—experiments, 84, 146;—motors and machines, 25;—works, 107.
- Hydraulics, practical—, 84.
- Hydrographic charts, 110.
- Illustrations of Papers, 6, 123, 133, 177.
- Improvement of rivers and harbors, 5, 109, 117, 125, 127, 160.
- of mouth of the Mississippi river, 37, 84, 120, 137.
- Index to Proceedings, 35, 58, 104, 178;—to Transactions, 142.
- Inland navigation, 24, 74.
- Institution of Civil Engineers, members, 171.
- Instruments of precision, 159.
- Insurance League. (See Civil.)

INTERNAL

- Internal improvements, 74, 75.
- International Exhibitions, engineering exhibits, 105, 126;—historical account, the Vienna—, 158. (See Centennial, Engineering, REPORTS.)
- Invitations, Annual Convention, 49, 82, 84.
- Iron, and steel. Government consumption, 89;—qualities of—, 86,—re-heating and re-rolling, 29.—Cast iron, 28,—malleable iron, 27.—Substitution for wood, 7. (See Board, Bridges, Tests.)
- Highway Bridges, properties of,—kind of bridges in use, American and European methods, strains in girders, 174.
- making countries, 160.
- Jets, discharge of water from—, 90.
- Jetties at South Pass, Mississippi River, progress of—, 37, 120;—construction in Europe, 108, 109. (See Improvements.)
- Joint meeting on Technical Education, 79. (See Technical.)
- Journal of the Society, cost and size, 141.
- Laboratory. (See Chemical.)
- Lake and river navigation, 25.
- Landscape work, 26.
- Lattice and plate girders, 107, 111. (See Girders.)
- Lawrence Water Works' pumping engines, a report, 116, 142.
- Laying Masonry in cold Weather, 30, 90.
- League, Civil Engineers' Insurance—.(See Civil, Mutual.)
- Lehigh Coal and Navigation Company. History of—, 48.
- Letter ballot, applied, 1, 49, 173;—approved, 152;—for appointment of special committees, 2, 153.
- Librarian to report, 125.
- LIBRARY AND MUSEUM, ADDITIONS TO—, 12, 34, 43, 55, 65, 93, 103, 114, 122, 131, 170, 176.
- Available to non-residents, 146.—Catalogue, described, 145.—Contributions, acknowledged, 146,—received through Centennial Commission, 144, 150,—solicited, 45, 95, 116, 133.—Expenditure recommended, 145.—Exchange of duplicates, 146.—Increase, 143.—State, 125, 144.—Value and usefulness, 145.
- Plan for founding—, committee, 82, 148,—report referred, 145.

VIII

LIFE

- Standing Committee appointed, 137.
- Life membership, proposed, 8.
- Light-houses in France, 128.
- LIST OF MEMBERS.—Additions, 14, 36, 46, 58, 70, 96, 104, 124, 134, 172, 178;—Changes and Corrections, 14, 36, 46, 58, 96, 104, 116, 124, 134, 172, 178;—Deceased, 14, 36, 96, 134, 178;—Resigned, 124, 172.
- Published as Supplement, 70.
- OF NEW BOOKS ON ENGINEERING AND TECHNOLOGY. (See BOOKS.)
- Locks and canals, 108, 110, 127.
- Locomotives, compressed air, 91;—exported, 77;—OLIVER EVANS' model, 95;—European, 127;—first American, 76;—shops, 71.
- Lyceum of Natural History, 40.
- Machinery at Vienna International Exhibition, 159.
- Magazines and papers received, 143.
- Mail coaches and steamboats, 76.
- Mains, discharge of water from-, 37.
- Maintenance of way on Swiss railroads, 107.
- Manufactures and manufacturing establishments in Europe, 160.
- Maps, French agricultural and geological-, 129.
- Maritime works in France, 128.
- Marine boilers. (See Connected.)
- Masonry, artificial blocks, 128;—foundations, 22;—in East River bridge, 38 (see Notes);—laying in cold weather, 30, 90;—nomenclature and classification (see Nomenclature);—rubble cement-, 162.
- Materials, effects of time, 48;—selection, 99, 162;—strength, 84;—resistance, 57.
- Means of averting Bridge Accidents, committee discharged, 82;—work, 146.
- Mechanical, engineer, 38, 151;—engineering, 22.
- Medal, Norman-. (See Norman.)
- Meetings, Announcements (see ANNOUNCEMENTS);—attendance, 71, 135, 139;—officers' receptions (see Officers);—sessions held, 139.
- of Centennial Commission of the Society, 13, 35, 45.
- Reports of-, 50.
- Members. Additions to- (see List);—ballots canvassed (see Ballots);—card to-, 45, 95, 133;—classification of-, 3, 80, 152;—deceased, 14, 36, 96, 134, 154, 178;—delinquent, 16;—elected, 1, 15, 37, 47, 59, 70,

MEMBERSHIP

- 96, 117, 125, 136;—list published 70;—location, 87;—memoirs, 96, 154;—nominations for special service, 80;—number and increase, 138;—photographs of-, 45, 95, 116, 133;—order of seniority, resident and non-resident-, 3, 152.
- of Institution of Civil Engineers, 171.
- Membership. Applications for admission, committee on-, 138;—conditions, 151;—certificate, 152;—efforts to increase, 151;—expulsion considered, 83, 136;—for life, 8;—income, 17;—number of applications, 138;—qualifications, 83;—voice of non-resident-, 90;—votes to exclude, 82, 136, 151.
- “Mémor of American Engineering”, a paper, 70, 135.
- Memoirs and records obtained by Centennial Commission of the Society, 4, 19, 21, 24, 39, 86, 149, 157.
- Memoranda. (See NOTES.)
- Memorials to Congress. (See Tests.)
- Metallic alloys, 28.
- Metallurgical engineering, 20.
- Metals, abrasion and wear, corrosion, 27;—distortion and strain, 48, 57, 171, 173.
- Metric System of Weights and Measures, 16, 31, 61, 178;—action proposed, 62;—Boston Society of Civil Engineers, circulars issued, 62, 178;—discussion had, 85;—subject considered, 151;—use in British India, 31.—Resolution for appointment of committee, 85, 137, 151;—ballot ordered, 173.
- Metrological Society, American-, 61.
- Milling and bread making, 159.
- Milwaukee Water Works' pumping engines, a report, 142.
- Mines, and tunnels, 91;—Columbia College School of-, 40.
- Mining Engineer, meaning of-, 38, 151.
- Engineers, American Institution of-. (See American.)
- MINUTES OF THE BOARD OF DIRECTION, 3, 16, 38, 49, 60, 86, 97, 104, 116, 124, 137, 173.
- January 5th, 1876.—Proposals for admission considered, Treasurer's report presented, appropriations made, committee appointed to arrange names of members in order of seniority, 3.
- February 2d, 1875.—Proposals for admission considered, Treasurer's report presented, 16.

MINUTES

- February 9th, 1876.—Appropriations made, statement relating to delinquent members, action taken, 16, —communication from Franklin Institute presented, committee on officers' receptions appointed, resolutions relating to Board to Test Iron, Steel and other Metals adopted, 17.
- March 1st, 1876.—Proposals for admission considered, reference to a Bill to establish a National Bureau of Architecture made, amendment to By-Laws referring to the term "Civil Engineer" and the question what is meant by it referred, committee appointed to arrange discussion on Technical Education, communication relating to experiments on railway traction acted on, 38.
- April 5th, 1876.—Proposals for admission considered, action relating to experiments on railway traction reconsidered, report from Joint Committee on Technical Education made, the Centennial Commission permitted to exhibit drawings, photographs and models of the Society, invitations to be extended to foreign engineers, resolutions referring to appointment of special committees approved, and ballot ordered, 49.
- May 3d, 1876.—Proposals for admission considered, introductions for foreign engineers ordered, 60.
- June 7th, August 2d, September 6th, 1876. — Proposals for admission considered, routine business done, 86, 105, 117.
- July 5th, 1876.—Meeting not held, 97.
- August 16th, 1876. — Reports on Change of the Society's Rooms and National Recognition of the Society, and resolutions, referring to Metric System of Weights and Measures, and to Uniform Accounts and Returns of Railroad Companies, presented at Eighth Annual Convention, considered, Committees on Quarters of the Society and on Uniform Accounts and Returns of Railroad Companies appointed, 137.
- October 4th, 1876.—Proposals for admission and preparation of Annual Report of the Board considered, Librarian instructed to report upon state and use of the library, 125.

MINUTES

- October 18th, 25th, 1876.—Preparation of Annual Report of the Board considered, 137.
 - November 4th, 1876.—Appointment of Standing Committees, referred, 137,—Committees on Revision of the Constitution, Change of Name of the Society, Nominations and Proposals for Membership, Fitting and Furnishing the Society's Rooms, Quarters of the Society, and Officers' Receptions, appointed, 138.
 - December 6th, 1876.—Proposals for admission considered, resolution referring to the metric system of weights and measures, presented at Eighth Annual Convention, submitted to ballot, 173,—rules for management of the library adopted, expression of thanks to JOHN B. JERVIS ordered, 174.
- MINUTES OF THE SOCIETY, 15, 37, 47, 59, 71, 97, 117, 125, 135, 172.
- January 5th, 1876.—Ballots for members and replies to circular referring to organization of Civil Engineer's Insurance League canvassed, communications read, Committee on Eighth Annual Convention to be increased, 1;—amendments to By-Laws referring to Conventions, officers' receptions, abstracts of papers, special committees on engineering subjects, duties of President of the Society, applications for professional service, and classification of resident and non-resident members, considered, action taken, 2.
 - January 19th, 1876.—Paper on the "New Portage Bridge" read, behavior of cement under different conditions considered, report from Centennial Commission made, the Exposition buildings and space to be had, described, 3.
 - February 2d, 1876.—Ballots for members canvassed, additions to resident Committee on Eighth Annual Convention announced, amendments to By-Laws, referring to Conventions and officers' receptions, adopted, 15;—"Notes and Suggestions on the Croton Water Works and Supply for the Future" read, discussed and referred, 16.
- February 16th, 1876. — Attention called to a Bill to establish a National Bureau of Architecture, com-

MINUTES

- munication referring to the metric system of weights and measures, and paper upon the "Practical Determination of Strains in the braced Arch" read, deaths of WILLIAM H. ASPINWALL and WILLIAM Y. ARTHUR announced, action taken, 16.
- March 1st, 1876.—Ballots for members canvassed, "Consumption and Waste of Water delivered by Public Works" read, report on "Progress of Jetties at South Pass of the Mississippi" presented, proposition to establish a science of money referred to, the "New Portage Bridge" discussed, 37.
 - March 15th, 1876.—Fall of an iron bridge, a scale for discharge of water in jets and from mains, and a new system of telegraphy described, 37;—the quantity of masonry in East River Bridge, and notebook of SIMEON S. POST referred to, 38.
 - April 5th, 1876.—Ballots for members canvassed, profile of South Pass bar, Mississippi river, presented, failure of dam at Worcester described, "Notes and Suggestions on the Croton Water Works and Supply for the Future" discussed, 47; a "Water Conduit under Pressure" announced, remarks made upon peculiarities of metals under strain, recent experiments on railway traction illustrated, resolutions relating to appointment of special Committees to report upon Failure of Dam at Worcester, and upon Resistances of Railway Trains, referred, 48.
 - April 19th, 1876.—"History of the Lehigh Coal and Navigation Company and its Works" read, "Notes and Suggestions on the Croton Water Works and Supply for the Future" discussed, 48.
 - May 3d, 1876.—Ballots canvassed for members and on appointment of Committees on Failure of Dam at Worcester and on Resistances of Railway Trains, dam at Worcester described, "Notes and Suggestions on the Croton Water Works and Supply for the Future" discussed, 59.
 - May 17th, 1876.—Foreign engineers received, 60.
 - June 7th, 1876.—Ballots for members canvassed, account of expedition to

MINUTES

- construct telegraph through Northern Asia given, 71.
- June 21st, 1876.—Meeting not held, 97.
 - July 7th, 1876.—Ballots for members canvassed, death of P. PORTER PONIER announced, committee appointed, 96.
 - September 6th, 1876.—Ballots for members canvassed, "Principles of tidal Harbor Improvement as applied at Wilmington, Cal.," presented, Committee on Time and Place of Ninth Annual Convention appointed, American engineering described, 117.
 - September 20th, 1876.—"Principles of tidal Harbor Improvement as applied at Wilmington, Cal.," read, behavior of a steam boiler during explosion of a rocky reef, described, 125.
 - October 4th, 1876.—Ballots for members canvassed, communications read, 125.
 - October 18th, 1876.—"Memoir of American Engineering" read, 135.
 - November 15th, 1876.—"Reconstruction and Enlargement of Cork Run Tunnel" read, 137.
 - December 6th, 1876.—"The Set and Decrease of Resistance of Metals subject to Distortion" read, resident members of Committee on Ninth Annual Convention appointed, 173.
 - December 20th, 1876.—"Connected segmental Marine Boilers, a Demonstration of the Principles of their Construction," read, 173.
- MINUTES OF THE EIGHTH ANNUAL CONVENTION, June 13th-16th, 1876, 71.—Attendance, 71.—First session. Address of Vice-President THEODORE G. ELLIS, "Rise and Progress of American Engineering", 73.—Chairman elected, "Bridges and Roofs" taken up; "Theory of Continuous Girders" and "Design and Erection of the Exposition Buildings", discussed, 78.—Announcements, Joint Meeting on "Technical Education"; Presentation from Austrian Society of Engineers and Architects. Second session. Amendments to By-Laws relating to applications for professional service, considered, 79.—substitutes offered, 80, 81.—amendment and substitutes rejected; resolution adopted;

MINUTES

invitations accepted; Committees on "Establishment of an Engineering Library and Museum" and on "Means of Averting Bridge Accidents" discharged; reports on "Change of the Society's Rooms" and on "National Recognition of the Society" presented. Number of votes necessary to reject an applicant, considered, 82,—laid on the table. Third session. "Bridges and Roofs" resumed; "The New Portage Bridge" and "Erection of the Verrugas Bridge" discussed, 83.—"Practical Hydraulics" taken up; "Waves of Translation that Emanate from a submerged Orifice", "Hydraulic Experiments with large Apertures", "Croton Water Works and Supply for the Future", and "Improvement of the Mouth of the Mississippi" discussed; Report on the "Guaging of Streams" accepted. Invitations presented. "Strength of Materials" taken up; Report on "Tests of American Iron and Steel" accepted, 84.—"Metric System of Weights and Measures", "Railroad Accounts and Returns" considered; resolutions asking appointment of committees referred. Reports on "Form, Weight, Life and Manufacture of Rails" and on "Failure of Dam at Worcester", 85,—"Nomenclature and Classification of Masonry", "Resistances of Railway Trains", and on "Technical Education" presented; action taken. Statement of Centennial Commission. Papers on "Guaging of Streams, a special Case"; "Cut-offs on the Mississippi", "Qualities of Iron and Steel", and discussions on "Croton Water Works and Supply", "Levees", "Metric System of Weights and Measures" and "Railroad Accounts and Returns" offered. Thanks tendered, and unfinished business referred, 86.

MINUTES OF THE TWENTY-FOURTH ANNUAL MEETING, November 1st, 1876, 135. Attendance, Annual Report of the Board of Direction read and accepted, 135;—ballots for members canvassed; officers for 1876-7 elected; report of Board of Censors to award the Norman Medal; time and place of the Ninth Annual

MISSISSIPPI

Convention fixed; reports on "Tests of American Iron and Steel", "Guaging of Streams", "Resistances of Railway Trains", and on "Uniform Accounts and Returns of Railroad Companies"; also of Centennial Commission of the Society and its Committee on Finance, accepted; action taken. Recommendations in report of Board of Direction referred, 136.—Head of Passes at mouth of Mississippi river described, 137. Mississippi river, cut-offs, 86, 95;—improvement of,—84;—jetties, 37, 120;—passes, 47, 137. (See Improvement, Jetties.) Money, science of,—37. MORSE, JAMES O.—Past Treasurer, thanks of the Board of Direction, 153. Motors and machines, 25, 78. Museum. (See LIBRARY.) Mutual Benefit Society, to aid families of deceased members; committee and work, 148. (See Civil.) Name of the Society, Committee on Change of,—138. National Recognition of the Society, federal charter, 87, 88;—report of committee, 82, 87, 137,—work, 148.—roads, 73. Navigation, inland,—24, 74. Netherlands, Engineering Exhibit at the Centennial Exposition, 108. (See Engineering.) "New Portage Bridge", a paper, read, 3;—discussed, 37, 83.—York & Erie Railroad, construction of,—38. Nomenclature and Classification of Masonry. Reports of Committee, 86, 88,—work, 147. Non-resident membership. (See Library, Members, Membership.) Norman Medal. Award, 146, 154,—change in conditions, 146;—papers for,—45, 95, 104, 146;—report of Board of Censors, 136, 154. North-Eastern Railway of Switzerland, manner of construction, 106. Note-book of SIMEON S. POST, referring to Construction of New York & Erie Railroad, 38. "Note on the Resistance of Materials as affected by Flow and Rapidity of Distortion", a paper, 57.—on the Strength of Materials as affected by Time", a paper, 48.

NOTES

- NOTES AND MEMORANDA, 3, 19, 38, 50, 61, 89, 97, 105, 118, 126, 161.
- Bridge Construction, American, 118; Fall of an Iron Bridge, 40; Bridges and Bridge Foundations, 113.—Centennial Commission of the Society, 3, 19, 38;—circulars sent out on—Bridges and Bridge Construction, 5.—Canals and inland Navigation, 24.—Electric Engineering, 5.—Foundations and Masonry, 22.—Gas Engineering, 23.—Hydraulic Motors and Machines, 25.—Mechanical Engineering, 22.—Metallurgical Engineering, 20.—Park and Landscape Work, Surveying and Geodesy, 26.—Railroads and rolling Stock, 23.—River and Harbor Improvements, 5.—Sewerage and Sanitary Engineering, 39.—Steam Engineering, 20.—Water Works, 4.—Civil Engineers' Insurance League, 8.—Committee Work, 120.—Compressed Air Locomotive, 91.—Concerning Conventions, 8, 30.—Dams for Reservoirs, 97, 161.—Determination of the Resistances of Railway Trains, 50.—Discharge of Water from Jets, 90.—Engineering Exhibits at the International Exhibition; Sketches of France, 126, Switzerland, 105, the Netherlands, 108.—Jetties at South Pass, Mississippi River, 120.—Laying Masonry in cold Weather, 30, 90.—Letter from SQUIRE WHIPPLE, 7.—Life Membership, 8.—Metric System of Weights and Measures, 31, 61.—Ninth Annual Convention, 164.—Reports of Meetings, 50.—Selecting Papers to be published, 6.—Selections from Correspondence, 6, 30, 40, 90, 97, 113, 118, 161.—Tests of American Iron and Steel, 26, 39, 51, 62, 89, 100;—action taken by American Institute of Mining Engineers, 51.—American Iron and Steel Association, 39.—Cornell University, 62.—Columbia College School of Mines, Lyceum of Natural History, Oberlin College, University of Michigan, 40.
- “on the Masonry of the East River Bridge”, a paper, 171.
- “and Suggestions on the Croton Water Works and Supply for the Future”, a paper, 35. (See Croton.)
- Oberlin College, 40.
- Officers, election by letter ballot, 152;—for 1876-7, 136;—of Annual Conventions, 8, 178.

ORDER

- receptions. By-Law, 15, 150, 153;—committee appointed, 17, 138, 152;—meeting held, 139. (See By-Law.)
- Order of business at Annual Convention, 78, 139.
- Orthogonal strains, 28.
- Pacific Railway, 77.
- Papers; abstracts of—, 2, 153 (see By-Laws);—extra copies, illustrations, 124, 133, 177;—for Norman Medal, 45, 95, 104;—engineering subjects, 123, 133, 177;—list of Papers, presented, 140,—published and unpublished, 141,—received, 35, 45, 57, 70, 94, 104, 171;—selection for publication, 6, 7.
- and magazines, received, 143.
- Parks and landscape work, 26.
- Passenger sloop, advertisement of—, 75.
- Pavement, slope wall—, 99, 161.
- Phenomena accompanying rupture of metals, 28.
- Photographs of members, 45, 95, 116, 133.
- Photo-tracings, how made, 107.
- Physical apparatus, 159.
- Piers for bridges, 110, 112, 113. (See Bridges, Engineering Exhibits.)
- Piles and pile drivers, 110.
- Pin connection trusses, 111.
- Pipes, cast-iron water— (See Water pipes.)
- Plate and lattice girders, 107, 111. (See Girders.)
- Plenum-pneumatic process of sinking foundations, 110.
- Policy of the Society, committee and work, 148.
- PONIER, P. PORTER.—Death announced, 96, 97;—committee appointed, 97;—memoir, 154.
- Port improvements of France, 148.
- POST, SIMEON S.—Note-book referring to Construction of the New York and Erie Railroad, 38.
- “Practical Determination of the Strains in the braced Arch”, a paper, 16.
- “Hydraulics” discussed, 84.
- President's duties, By-Law, 2, 153.
- “Principles of tidal Harbor Improvement, as applied at Wilmington Harbor, Cal.,” a paper, 104, 117, 125.
- Proceedings, Index to—, 35, 58, 104, 142, 178.
- Professional subjects, committees on—, 146.
- Propeller, FITCH's steamboat and—, 74.
- Publication of Papers, considered, 6, 142.

PUBLICATIONS

- Publications received, 144.
 Public improvements, a century ago, 73 ;
 —of France, 129.
 Puddle walls, how made, 99, 162.
 Pumps, air-, 111 ;—for water supply,
 128, 160.
 Pumping engines, 109, 116, 128, 142,
 161.
 Qualifications of applicants for mem-
 bership, discussed, 83.
 "Qualities of Iron and Steel," a paper,
 86, 94.
 Quarterly receipts and expenditures, 18.
 Quarters of the Society, committee
 appointed, 138,—work. 150. (See
 Rooms.)
 "Railroad Accounts and Returns" dis-
 cussed, 85, 86. (See Uniform.)
 — cars, locomotives and rails, 127 ;—
 surveys and work, 107.
 Railroads and rolling stock, 23 ;—prog-
 ress in-, 76.
 Rails, cars and locomotives, 127 ;—
 Form, Weight, Manufacture and
 Life of-, report of committee, 86,
 —its work, 146.
 Railway, construction and cost, 106 ;
 —Signals, committee on-, 85,—its
 work, 146 ;—the North-Eastern,
 106,—Orleans, 127,—Pacific, 77 ;—
 traction, 38, 48, 50. (See Resist-
 ances.)
 Rainfall and existing water supply. (See
 Gauging.)
 Receptions, officers'-. (See Officers.)
 Recommendations of the Board of Di-
 rection, referring to—Amendments
 of the By-Laws, 1, 2, 15, 78, 153 ;
 —election and expulsion of mem-
 bers, 136, 151 ;—form of publica-
 tion, 136, 142 ;—increase and use
 of library, 145, 145 ;—letter ballot
 for officers, 152,—on resolutions,
 48 ;—officers' receptions, 150.
 "Reconstruction and Enlargement of
 Cork Run Tunnel", a paper, 58,
 137.
 Re-heating and re-rolling metals, 29.
 REPORTS as follows :—
 — BOARD OF CENSORS TO AWARD
 THE NORMAN MEDAL, 154.
 —November 1st, 1876.—No award
 made, 154.
 — BOARD OF DIRECTION, 138.
 —November 1st, 1876.—Members, num-
 ber and increase, 138.—Meetings
 held, evening meetings, officers'
 receptions, Eighth Annual Con-
 vention, order of business, 139.—Pa-

REPORTS

- pers presented, published and not
 published, cost and size of the
 Journal, 141.—Contents of "Pro-
 ceedings", volumes closed, title
 pages and index issued, "List of
 Members", merging "Transac-
 tions" and "Proceedings", 142.—
 Appendixes to the Journal, increase
 of library, periodicals received, 143.
 —Transactions in exchange, state
 of library, contributions per Cen-
 tennial Commission, 144.—Cata-
 logue, expenditure recommended,
 founding an engineering library,
 145.—Donations asked, duplicate
 copies, use of library to non-resi-
 dents, thanks to donors, award of
 Norman Medal, committees on pro-
 fessional subjects, and for special
 work, 147.—Civil Engineers'
 Insurance League ; the Centennial
 Commission, its plan, 148,—sub-
 committees, rooms, memoirs, ex-
 penses and results ; American In-
 stitute of Mining Engineers, 149.—
 Courtesies to foreign engineers,
 Society's rooms, permanent quarters,
 evening's use, officers' receptions,
 150.—Metric system of weights and
 measures, fee of Fellows, and other
 members, increase of each class,
 conditions of membership, votes to
 exclude, expulsion of members, ac-
 tion recommended, 151.—Definition
 of Civil Engineer, residents and
 non-residents, letter-ballot, appoint-
 ment of special committees, election
 of officers, certificates of member-
 ship, seniority of members. Changes
 in the By-Laws, referring to special
 committees, Annual Conventions,
 Honorary Members, officers' recep-
 tions, and abstracts of papers, 152.
 —Action taken, thanks to Past
 Treasurer, Treasurer's annual re-
 port, 153.—Deceased members, 154.
 — CENTENNIAL COMMISSION OF THE
 SOCIETY, 156.
 —November 1st, 1876.—What was pro-
 posed and done, space filled, ex-
 hibits elsewhere, state of engineer-
 ing represented, work of Resident
 Secretary, increased respect for
 American engineers, 156.—Benefit
 to the Society, memoirs to be pub-
 lished, funds required, 157.
 — CHANGE OF THE SOCIETY'S ROOMS,
 87.
 —June 14th, 1876.—When present lease
 expires, action with other societies,
 what is recommended, 87.

REPORTS

- COMMITTEE ON FINANCE, CENTENNIAL COMMISSION, 157.
- November 1st, 1876.—Amount paid, sum needed, 157.
- Lawrence Water Works, pumping engines, 116, 142.
- Meetings. Determination of the Resistances of Railway Trains, 50. (See Resistances.)
- Milwaukee Water Works, pumping engines, 142.
- NOMENCLATURE AND CLASSIFICATION OF MASONRY, 88.
- June 15th, 1876.—Resolution forming committee, scheme of operations determined, members' reply to circulars, drawings prepared, 88,—action to be taken, progress reported, 89.
- SECURING A NATIONAL RECOGNITION OF THE SOCIETY, 87.
- June 14th, 1876.—A federal charter recommended, membership of the Society, numbers and location, work done and progress made, the Centennial Commission, 87.—Object and design of the Society; an insurance on public improvements, to have governmental recognition, 88.
- TESTS OF AMERICAN IRON AND STEEL, 60, 155.
- May 11th, 1876.—Action required, economy demanded, results described, 60;—aid requested, 61.
- November 1st, 1876.—Efforts made, testing machine incomplete, unpended balance, services rendered, payments made, appropriation asked, aid requested, 155.
- the Treasurer, 3, 16, 135, 138.
- TIME AND PLACE OF NINTH ANNUAL CONVENTION, 154.
- November 1st, 1876.—Canvass of votes, no choice, communications presented, 154.
- UNIFORM ACCOUNTS AND RETURNS OF RAILROAD COMPANIES, 187.
- November 1st, 1876.—Accounts and returns in Massachusetts, interview with chief accountant, appointment of committee, with power, recommended, 157.
- UNIFORM METHOD OF GAUGING STREAMS, 61.
- May 30th, 1876.—No uniform method applicable, comparison of records desirable, complete record kept by the Smithsonian Institute, 61.—Discussion by J. J. R. CROES, 118.
- Vienna International Exhibition, 158. (See Vienna.)

REPORTS

- Reports, copies for library, requested, 146 (see ANNOUNCEMENTS);—made to the Society, 140;—unpublished, 141.
- Resident membership. (See Members, Membership.)
- Secretary of Centennial Commission of the Society, 5, 39, 48, 156.
- Resigned members, 124, 172.
- Resistances of columns and girders, 27;—materials, 57;—metals, 171, 173.
- of Railway Trains. Determination of—, elements of resistance, 50,—dynamometer described, cause of variation, economical speed, friction of journals, 51.—Subject discussed, 38, 50,—resolution offered, 48, 49,—ballot had, 59,—reports, 86, 136,—committee and work, 147.
- Resolutions, relating to—accounts and returns of railway companies, 85, 137;—amendments to By-Laws, 38,—to Constitution, 83;—death of WILLIAM Y. ARTHUR, delinquent members, 16;—failure of Worcester dam, 48;—metric system, 85, 137, 151, 173;—Mutual Benefit Society, 148;—professional service, 80, 81, 153;—resistances of railway trains, 48;—special committees, 48, 49, 82, 85, 137, 151, 173;—testing iron and steel, 17, 30.
- “Rise and Progress of American Engineering”, address by THEODORE G. ELLIS, 73. (See Address.)
- River, and harbor improvement, 5, 73, 108, 109, 117, 125, 127, 160,—and lake navigation, 25.
- Road construction, French, 126;—government roads, 74.
- Rock-drilling machinery, 106.
- Roofs and bridges, 78, 83.
- Rooms of the Centennial Commission, 17, 19, 39, 70;—of the Society, Committee on Change of—, 82,—report, 87, 137,—on Furnishing, 138.—Location, use, 87, 150. (See ANNOUNCEMENTS, Quarters.)
- Rubble cement masonry, 162.
- Sanitary engineering, 39.
- School of Mines, Columbia College, 40.
- Schools of engineering, 77, 129, 160.
- Science and education, 159.
- “Securing a national Recognition of the Society.” (See National.)
- Selections from Correspondence, 6, 30, 40, 90, 97, 113, 118, 161. (See NOTES.)
- Secretary of Board to test Iron, Steel and other Metals, 84, 89, 155.

SENIORITY

- of Centennial Commission, Resident, 5, 39, 48, 156.
- Seniority of members, committee on—, 3, 152.
- Sewerage, 39, 77.
- Sewing machines, 160.
- Sheep and wool, 159.
- Signals, railway, 85, 146.
- Sketches of Engineering Exhibits at the International Exposition, 105, 126. (See Engineering.)
- Slope wall pavement, 99, 161.
- Sloop, advertisement of passenger—, 75.
- Smithsonian Institution, records of rainfall, 61.
- Society (The). Design and object, 88 ; —progress made, work done, 87.
- Solar heat, the motor of the future, 78.
- Special committees on engineering subjects. (See Committees, Resolutions.)
- Specifications for an Earthen Dam, 98, 161 ;—for railroad work, 107.
- Spiling walls, 97, 99, 162.
- Stage routes, advertisement of—, 75.
- STATEMENT OF THE FINANCES OF THE SOCIETY, 17.
- Statistics of European manufactures, 160.
- Standing Committees appointed, 137.
- Steamboat, FITCH's, 74, — FULTON's, 75 ;—steamboats and mail coaches, 76.
- Steam, boilers, 125, 160,—engineering, 20 ;—engines, 74, 95, 159 ;—EVANS' locomotive, 95 ;—traction, 160.
- Steel, compressed—, 160 ;—for tools, produced by modern processes, 29 ;—qualities of—, 86 ;—series for testing, 27. (See BOARD, Committees, Iron, Tests.)
- Stern wheel, 74.
- Stone culverts, 107 ;—for gate-house and well, 99, 162.
- Strains, in girders, 160, 174 ;—in metals, 48 (see Resistances) ;—in the braced arch, 16, 57 ;—orthogonal—, 28.
- Streams, gauging of—. (See Gauging.)
- Strength of materials, 48, 84.
- Sub-committees of the Centennial Commission of the Society, members and work, 3, 38, 149.
- Superstructure of bridges, 120.
- Surveying and geodesy, 26.
- Surveys in Switzerland, 107.
- Swing bridges, 126, 128.
- Switzerland, Engineering Exhibit at the Centennial Exposition, 105. (See Engineering.)

TABLES

- Tables of sizes and strength of chain cables and wire ropes, 27.
- Technical Education, joint discussion of—, committees appointed, 38 ;—meetings held, 79 ;—reports, 49, 86, 171 ;—work, 147.
- Telegraphs, expedition through Northern Asia, 71 ;—report on—, 159.
- Telegraphy, fac-simile—, described, 37, 58.
- Test loads, deflections of bridges, 107.
- Tests of American Iron and Steel.—Aid required, 60, 85, 155.—Appropriations asked, 29, 30, 35, 40, 51, 84, 90, 100, 155.—Committee reports, 60, 84, 155.—memorials to Congress, 30, 85,—work, 146.—Investigations of—, Abrasion and Wear, Armor Plate, Cast Iron, Chains and Wire Rope, Chemical Research, Corrosion of Metals, Effects of Temperature, Girders and Columns, Malleable Iron, Metallic Alloys, Orthogonal Strains, Physical Phenomena, Re-heating and Re-rolling, Steel produced by modern processes, Tool Steel, 27.—Knowledge desired, 87,—its value, 90.—Proportions of test pieces, 27.—Results obtained, 29, 60.—Scientific research necessary, 89.—Testing machine, 29, 89, 155. (See BOARD, Committees, Iron, Steel.)
- "Theory of continuous Girders in Relation to Economy of Bridge Building", a paper, 45.
- Tidal harbor improvement. (See Principles.)
- Timber bridges, WERNWAG's—, 75.—Culture and use of timber, 159.
- Time, and place of Annual Convention, 136, 154, 164 ;—as affecting strength of materials, 48.
- Topics for discussion at Annual Convention, 57, 69, 139.
- Tool steel, 29.
- Toothing, 99, 162.
- Traction, railway—, 48. (See Railway.)
- Transactions, contents, 13 ;—cost and size, 141 ;—form of publication, 136, 142 ;—to delinquent members, 16,—topical index, 142.
- Treasurer's reports, 17, 135, 153 ;—retirement of JAMES O. MORSE, 153.
- TREVITHIC, EVANS, and HULL, 74.
- Tunnel, Cork Run, 58, 137 ;—St. Gothard—description, time for completion, men employed, machinery used, progress made, geologic record, 106. (See Compressed.)
- Tunnelling, American, 45.

UNIFORM

- Uniform Accounts and Returns of Railroad Companies.—Committee appointed, 136, 137; — report, 136, 157,—work, 147. (See Railroad.)
- Method of Gauging Streams. Discussion of Report, 118. (See Gauging.)
- United States Board to test Iron, Steel and other Metals. (See BOARD.)
- University of Wisconsin, 40.
- Verrugas bridge, erection of—, 83.
- Viaducts, in America, 77,—France, 126, 160,—the Netherlands, 111.
- Vienna International Exhibition, Reports on—. Commissions appointed, reports made; historical accounts of international exhibitions; foreign reports on American exhibits; editor's preface, 158.—Reports on forestry, culture and use of timber, sheep and wool, milling and bread making, physical apparatus, instruments of precision, telegraphs, primary education, printing and government publications, steam engines, motors, pumps, tools, propulsion, 159,—valve motions, steam traction, air and gas engines, water wheels, compressed steel and bronze, European manufactures and manufacturing establishments, iron making countries, sewing machines,

VOLUMES

- civil engineering, rivers, canals and hydraulic work, architecture, exhibition buildings, iron and steel, metallurgy. The index, 160.
- Volumes closed. Index and titles, 142, 178.
- Walls, artificial blocks for—, 128;—cut-off, spiling, and puddle walls, 97, 99, 162.
- WASHINGTON's reports on canals and river improvements, 73.
- "Water Conduit under Pressure", a paper, 48, 58.
- and waste pipes, cast iron, 98, 161;—discharge from jets and mains, 90;—distribution, 128;—flow of—, power in Switzerland, 108.
- Water works, a circular, 4, 71;—exhibits at Centennial Exposition, 171;—pumping engines, 109, 116, 128, 142, 161. (See Consumption, Croton.)
- "Waves of Translation that emanate from a submerged Orifice", discussed, 84.
- Weights and measures. (See Metric.)
- Weirs, construction of—, 108.
- Well and gate-house, 99, 161.
- WHIPPLE, SQUIRE—, letter, 7.
- WILLIAMS, WILLIAM.—Death announced, 134;—memoir, 154.
- Wire ropes and chain cables, 27.
- Wooden bridges. (See Bridges.)